In re Application of: Anthony C. Zuppero et al. Art Unit: 1753

Serial No.: Not Yet Known Examiner: Diamond, Alan D.

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TITLE: **GAS SPECIE ELECTRON-JUMP CHEMICAL ENERGY CONVERTER**

Mail Stop Patent Application
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

PETITION TO MAKE SPECIAL UNDER THE ENERGY PROGRAM
(37 C.F.R. 1.102(c) AND M.P.E.P. 708.02, VI)

SIR:

Applicants hereby petition to make the above-identified application special for an invention that materially contributes to the development or conservation of energy resources and significantly benefits the environment.

The present application discloses methods and apparatus for the conversion of chemical energy of fuels and oxidizers such as hydrogen, ethanol and methanol or hydrocarbons directly into electrical energy or other useful forms, and does so in a compact and efficient manner, and specifically when applied to transportation.

The mass required to develop a given net electric power can be as much as an order of magnitude less than that of an internal combustion engine. This reduction in "engine" mass translates

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directly into a reduction of vehicle weight. The reduction in vehicle weight translates directly and almost linearly to a reduction of fuel required. The present application enables an increase in electric generator power per mass, which directly decreases the parasitic engine and structure masses and hence increases the system fuel efficiencies, for instance, of transportation systems.

A direct benefit to the environment will also result because of reduced consumption of fuel and because of the way in which the exemplary embodiments convert fuel/air directly into electricity, without combustion. This is exceptionally important when the exemplary embodiments are used to electrically power, for example, public transport such as automobiles.

The exemplary embodiments use a new pathway for the conversion of chemical energy into electricity. Highly vibrationally excited state chemical specie give up a substantial fraction of the vibrational energy directly to a single electron as soon as the excited molecule bumps into a conducting surface. The electron promptly becomes a "hot electron" in the conductor, carrying away a substantial fraction of the reaction energy.

The exemplary embodiments create the highly vibrationally excited specie using a chemical reaction of fuel and oxidizer. A major fraction of the chemical energy of the reaction appears first in the vibrational excitation of the reactants. Although collisions of the reactants quickly degrade the energy, such degradation occurs sufficiently slowly, typically taking between 10 and 10,000 collisions, and the exemplary embodiments may collect a substantial fraction of the energy. To achieve energy collection before substantial degradation, the excited reactants are created on or within an energy-mean free path of a conducting surface, which dimension is, for instance, between 100 to 500 nanometers (0.1 to 0.5 microns).

The hot electron injected into the conducting surface is converted into a useful electrical potential by the use of semiconductor diode devices similar to those used in photovoltaic devices.

The conducting surface, formed directly on the semiconductor, is formed sufficiently thin, of an order less than an energy mean free path for a hot electron, so that the electron is transported practically ballistically into the semiconductor diode. This thickness is typically of an order 1 to 10 nanometers.

The semiconductor energy conversion device, which can be, for example, a p-n junction diode or a Schottky diode or other energy collection/conversion device, becomes forward biased. This forward bias is the same as similar to the forward bias generated by light in photovoltaic devices. However, the forward bias of the exemplary embodiments are generated from a hot electron which was emitted when vibrationally excited fuel / air reaction products contacted the conducting surface.

The net effect is a clean and efficient conversion of the chemical energy directly into electricity.

The fuel/air reaction is stimulated to occur using catalysts and on catalyst surfaces and is therefore relatively cold, compared to combustion, with temperatures below 800 C. The low temperature mitigates production of unwanted NOx. The temperature of operation of a device in accordance with the present application can be as low as hundreds of degrees Kelvin, which is much lower than the typical operational temperatures of conventional thermophotovoltaic and thermionic systems (1500 to 2500 Kelvin). Moreover, the power per mass and power per volume ultimately achievable using pre-equilibrium emissions in accordance with the present application exceeds that of all known fuel cells, conventional thermo-photovoltaics, and conventional thermionic systems.

Furthermore, in comparison to fuel cells which require complex ducting, devices in accordance with the present application allow mixing of fuel and air in the same duct, thereby simplifying ducting requirements. The combination of high volume and mass power density, simplicity, and lower temperature operation makes the methods and devices of the present application competitive and uniquely useful.

The present application includes subject matter which directly applies to the conservation of energy resources. In transportation applications, for example, the methods and apparatus of the present application can dramatically reduce the amount of fuel consumed while producing no polluting emissions. Fuels that can be used with the present application include, for instance, the biofuels ethanol and methanol.

By operating at temperatures well below that of solid oxide fuel cells, the systems and methods of the present application generate no NOx pollutants. The present application can achieve system fuel enthalpy efficiencies similar to the theoretical ultimate efficiency of fuel cells. In contrast to competitive engines, systems in accordance with the present application can be scaled to a very small size with no change in specific power per mass or efficiency.

For the aforementioned reasons, it is respectfully submitted that the present application discloses an invention which materially contributes to the development or conservation of energy resources and materially enhances the quality of the environment. It is therefore respectfully requested that the present application be made special and that the examination thereof accordingly be accelerated.

No fee is believed to be required. Should any fee be due, please charge Deposit Account No. 02-0393 of Baker & McKenzie.

Respectfully submitted,

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